3.0 Environmental Monitoring

3.1 Water Monitoring

3.1.1 Introduction

This section presents data collected to satisfy water monitoring objectives implemented at the Site in accordance with RFLMA. The RFSOG provides a guidance framework in support of conducting LM activities at the Site including monitoring. Figure 3-1 shows a map with the water monitoring locations that were operational during fourth quarter CY 2007. Sampling maps for the first through third quarters of CY 2007 can be found in the respective quarterly reports.

This annual report presents data collected during CY 2007 (January through December 2007). This section includes:

- An evaluation of analytical results from routine monitoring as required by RFLMA and detailed in the RFSOG, organized by monitoring objective;
- A summary of hydrologic data for the CY; and
- Supplemental data interpretation and evaluation for CY 2007.

Analytical water-quality data are available in Appendix B.

3.1.1.1 Water Monitoring Highlights: CY 2007

During CY 2007, the water monitoring network successfully fulfilled the targeted monitoring objectives as required by RFLMA and using the RFSOG implementation guidance. During CY 2007, the RFLMA network consisted of 100 wells, 16 gaging stations, 14 surface-water grab sampling locations, 10 treatment system grab sampling locations, 10 precipitation gages, and 3 pre-discharge pond monitoring locations. During CY 2007, 201 samples composed of 7,145 individual grabs were collected at the surface-water locations[1] and 149 samples were collected from monitoring wells. Additional samples were collected beyond the RFLMA requirements as discussed in this report.

CY 2007 was nearly average with approximately 11.55 inches of precipitation, which is 92 percent of average (CY 1993−2006 average of 12.53 inches). The winter was significantly wetter than average due to snow events. December and January were significantly wetter than average (196 percent and 173 percent of average, respectively), while June, July, and November were significantly drier than average (25 percent, 48 percent, and 26 percent of average, respectively). The largest events occurred on April 24 (1.53 inches), and September 24 (0.89 inches).[2] The largest 2-day total (1.61 inches) occurred on April 23−24. The highest peak flow rates for the year from the COU were during the April 24 event. Peak flows were 11.74 cubic feet per second (cfs) in North Walnut Creek, 12.07 cfs in South Walnut Creek, and 4.09 cfs in the South Interceptor Ditch (SID).

[1] Composite samples consist of multiple aliquotts ("grabs") of identical volume. Each grab is delivered by the automatic sampler to the composite container at each predetermined flow volume or time interval.
[2] The precipitation gages used in the automated surface water monitoring network are not heated due to the lack of AC power at the locations. As such, the gages do not accurately measure snowfall (as water equivalent).

All water-quality data at the RFLMA Points of Compliance (POCs) remained well below the applicable standards through all of CY 2007.

Reportable 12-month rolling average total U concentrations continued to be observed in surface water at RFLMA POE monitoring station GS10, which is located in South Walnut Creek upstream of Pond B-1 in the Walnut Creek Basin. DOE provided the initial formal notification of reportable U concentrations at POE GS10 to EPA and CDPHE on July 13, 2006. DOE first became aware of the reportable values when all U sample results were validated on July 6, 2006. This notification reported, on a 12-month rolling average basis per the Integrated Monitoring Plan (IMP), a single reportable value for the last day of April 2006 (April 30, 2006; 10.19 pCi/L). At that time, the RFCA action level for total U in Walnut Creek was 10 pCi/L, as adopted by RFLMA.

A more comprehensive water-quality evaluation was detailed in Section 2.2.1.1, "Notification and Source Evaluation for Reportable 12-Month Rolling Total U Values at RFCA Point of Evaluation GS10" of the *Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2006* (DOE 2006g). The Site continues to evaluate, in coordination with CDPHE and under RFLMA, the measured U concentrations at GS10. Recent GS10 data are evaluated in Section 3.1.2.2 of this report.

All other POE analyte concentrations remained below reporting levels for all of CY 2007. Erosion and runoff controls, as well as extensive revegetation efforts, have proven to be effective in measurably reducing both sediment transport and constituent concentrations. During CY 2007, all of the POEs showed plutonium-239,240 (Pu) and americium-241 (Am) concentrations well below the RFLMA standards. With the removal of impervious areas resulting in decreased runoff, the stabilization of soils within the drainages, and the progression of revegetation, acceptable water quality is expected to continue.

Groundwater monitoring results at the PLF and OLF are evaluated in Section 3.1.2.8 and Section 3.1.2.9, respectively. Groundwater was monitored in accordance with RFLMA (DOE 2007d).

3.1.1.2 Use of Analytical Data

Analytical data are evaluated statistically to meet many objectives in accordance with RFLMA. Rejected data are not included in statistical evaluations.

Surface-water data from POCs and POEs are evaluated on a semimonthly schedule, and results of these evaluations are included in the quarterly reports. Details regarding data handling for all surface water can be found in Appendix B.

Groundwater data evaluations are reported annually, because the groundwater regime is less dynamic and conditions change much more gradually than is the case with surface water. However, groundwater data from Area of Concern (AOC) wells are evaluated for reportable conditions as they are received; when such conditions exist, they are described in the corresponding quarterly report as well as the annual report.

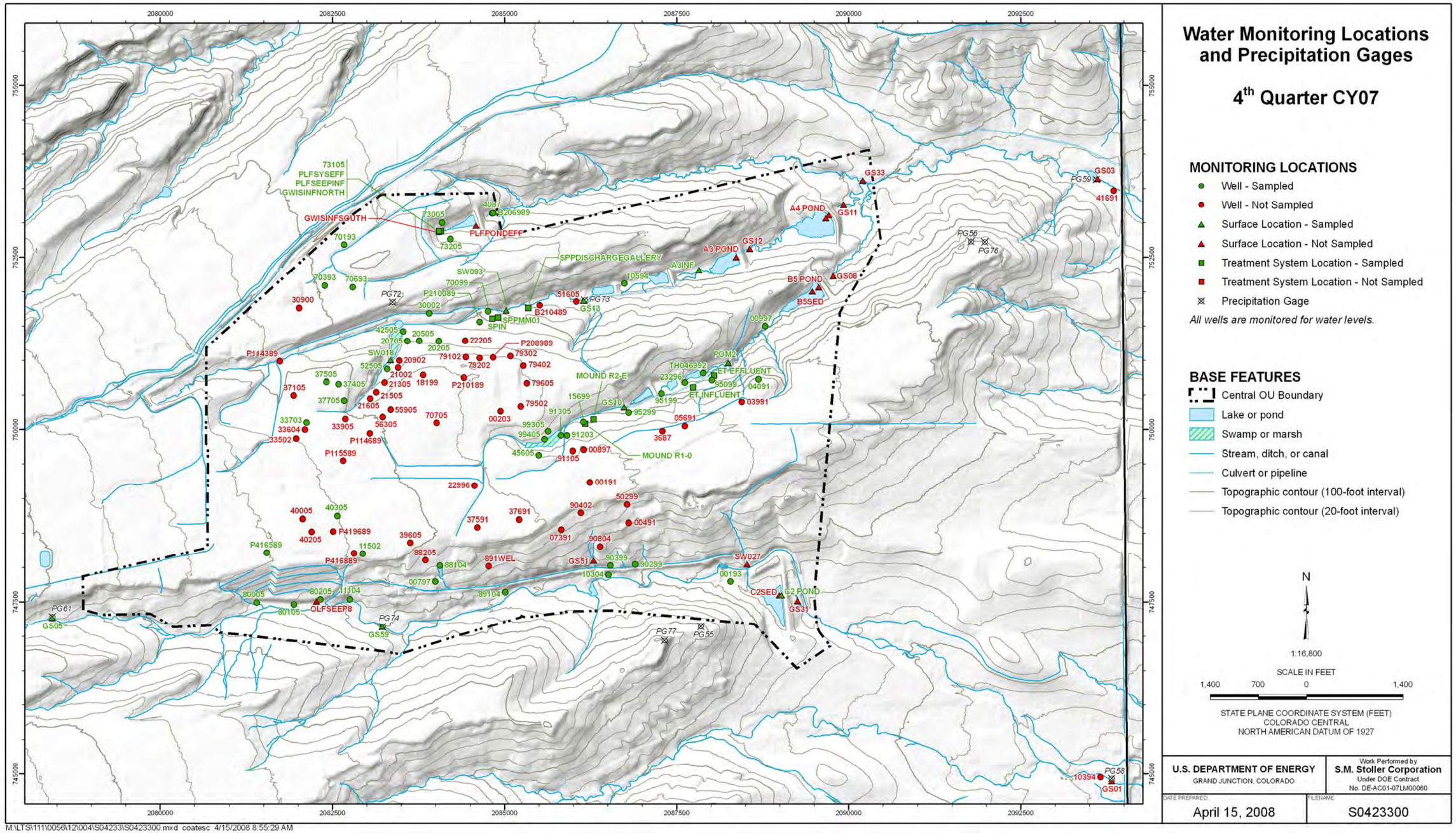

Figure 3-1. RFS Water Monitoring Locations and Precipitation Gages: Fourth Quarter CY 2007

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Groundwater statistics require a minimum of eight results representing routinely collected samples. A commercially available geostatistical software program (e.g., Sanitas™ or Visual Sample Plan) is used for these calculations. (Note: This report does not recommend any particular software; this information is merely included for the sake of completeness.) For trend calculations employing the Seasonal-Kendall (S-K) statistical method, a further requirement is for the data representing these routinely collected samples to comprise four sets of results per season. For example, wells required to be monitored semiannually are sampled in the second and fourth quarters of a CY. Trending will require a minimum of eight sets of results from routinely collected samples, distributed as four per season—four in the second quarter and four in the fourth quarter. In this example, therefore, a well would need to be sampled for 4 years (4 samples × 2 samples/year = 8 samples total; 4 each of second-quarter samples and fourth-quarter samples requires 4 full years of semiannual samples) to provide the necessary and appropriate data for statistical analysis. For wells sampled quarterly, although the minimum eight sets of results could be collected in 2 years of routine sampling, the minimum four sets of results per season (four seasons) would not be collected until 4 years of successful, routine sampling had been completed.

Groundwater field duplicates are omitted from statistical evaluations. Groundwater samples assigned laboratory qualifiers of J (estimated) are taken at face value, rather than being assigned a value of less than the method detection limit plus the practical quantitation limit (PQL). Samples qualified with a B (for organics, indicates the constituent was also detected in the blank) were also used at face value. This qualifier is commonly associated with results for methylene chloride. Because this compound is a commonly used laboratory solvent, B-qualified results should be carefully reviewed alongside corresponding detection limits, concentrations in the blanks, and other relevant data before basing any decisions on them. (Note: In some cases, these considerations have led to the results being assigned a validation qualifier including "U," signifying that the result is so suspect as to be considered a nondetect.)

The RFSOG (DOE 2007f) instructs that nondetects reported for groundwater data be replaced by zeroes when performing statistical assessments. However, to calculate trends the data cannot contain zeroes. Therefore, instead of zeroes, nondetects are replaced with a value of 0.001. (Note that this includes data with lab qualifiers as well as validation qualifiers that include "U.") Likewise, the statistical program cannot perform the necessary calculations if negative numbers are included in the results, as is occasionally the case for U isotopes and other radionuclides. Therefore, any negative U isotope-specific results were replaced with 0.001, then isotopes were converted to mass units and summed to provide a conservative estimate of total U in mass units. Calculated trends may be strongly affected by this data replacement; therefore, the data from calculated trends of interest should be carefully inspected before any conclusions are reached or decisions made.

Evaluations of U in groundwater are based on total U concentrations. In some cases, surface-water data are also evaluated (e.g., at GS13, the performance monitoring location supporting the SPPTS). The latter data, as well as some earlier groundwater data, are typically reported as isotopic activities. Any negative values for individual isotopic analyses were first replaced with 0.001, then the individual results for a given location/date were converted to mass units and summed to provide a conservative approximation of total U by mass. Replacement with 0.001 was also performed for any total U results that were equal to or less than zero to allow for the

requirements of the statistical calculations. Conversion factors used to support these groundwater evaluations are listed in Table 3-1.

Table 3-1. U Isotope Conversion Factors Used in Groundwater Evaluations

Isotope	Conversion Factor	Typical Activity Units	Typical Mass Units
U-233[a]	9636.6 pCi/µg	pCi/L	µg/L
U-234	6235.1 pCi/µg	pCi/L	µg/L
U-235	2.1612 pCi/µg	pCi/L	µg/L
U-236[a]	64.672 pCi/µg	pCi/L	µg/L
U-238	0.33614 pCi/µg	pCi/L	µg/L

Notes: [a]U-233 and U-236 are absent in natural U, and therefore can be used as definitive markers for anthropogenic U. LANL analyzes U-236 and also evaluates isotopic ratios for this purpose.
Source of conversion factors: Friedlander et al. 1981.
pCi/µg = picocuries per microgram

There are many instances in the database of multiple results for U on the same date at the same well (representing any or all of the following: isotopic analysis providing results in activity units, isotopic analysis providing results in mass units, total U analysis via a metals analytical method, total U via a total U analytical method, filtered sample, and unfiltered sample). Before trends were calculated, for each well where this applied these multiple results were winnowed to a single result representing each unique date. Factors evaluated in selecting the result for statistical use included:

- Filtration status;
- Validation qualifier(s);
- Lab qualifier(s); and
- Other U results from the well.

Because most samples were field-filtered, where both sample results are provided the filtered result is typically preferred for reasons of consistency. Similarly, where two very different results are presented, that most similar to other results from the well is retained; if the two are similar, the higher-concentration result is retained to be conservative.

Data from original wells are grouped with those from replacement wells to form a data set on which the statistics are based. As additional data are collected from replacement wells, most of which were installed in 2005, this may prove to be inappropriate given that the data populations from original and replacement wells may be discontinuous, suggesting data from the original well(s) be removed from statistical assessments of the groundwater data. This determination will be made as the post-closure data set becomes large enough to allow such an evaluation. Therefore, it should be stressed that trends calculated for replacement wells may be misleading in that they may be strongly affected by well replacement, as opposed to reflecting only groundwater geochemistry and hydrology.